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31 May 1966, DoDD 5200.10; BUSHIPS ltr, 1 Apr 1968	

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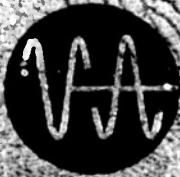
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Engineering Report
No. 132-23

Copy No. 6

**V-52 KLYSTRON OSCILLATOR
REFINEMENT AND PRODUCTION PROGRAM**

Progress Report for
May 1954

Prepared for: Bureau of Ships
Navy Department

On: BuShips Contract No. N0bs-5358

By: Claude Conner and David Clifford

Approved:

E. G. Cameron
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Chief Product Engineer

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PURPOSE

The purpose of the program covered by BuShips Contract No. NObs-5358 is to refine and produce one thousand (1000) rugged X-band local oscillator V-52 klystrons. This tube is to comply with the specifications of SHIPS E-720, which were subsequently modified at a conference held at the Bureau of Ordnance, Washington, D.C. on 20-21 May 1952 and later at a conference held at Varian Associates on 29-30 September 1952.

PROGRESS

An experimental group of 16 tubes has been tested¹ in which a higher "pretune" frequency was used. All tubes were tested with invar tuning screws in the external cavity and some were retested with the normal steel screw. The results were quite encouraging in that approximately 69 per cent of the tubes were within ± 3 mc (31 per cent of the total were within ± 2 mc) when tested with the invar screw. With the particular pretune frequency used, a gain in compensation of approximately 2 mc was achieved at 8.8 kmc and approximately 1 mc at 9.6 - when compared to the values obtained with the steel screw - thus tending to "level" the drift over the tuning range. The purpose of using a higher pretune frequency was two-fold (see Figure 1). The first purpose was to produce more screw insertion at 9.6 kmc so that greater advantage could be taken of the differential expansion between the external cavity and a dissimilar screw material. The second purpose was to shift the tuning curve of the external cavity so that the slope at the 9.6 kmc end would be equal to, or greater than, the slope at 8.8 kmc. (With the present pretune frequency, the 9.6 kmc end occurs at a low slope portion of the curve.) It should be noted that greater compensation is attained at the 8.8 kmc end (with the invar screw) simply because there is more screw insertion. Furthermore, some of the variation in drift from tube to tube

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is attributable to changes in pretune frequency² caused by window sealing since this affects the position of the tuning curve relative to the band limits. It must be pointed out also that curve variations result from external cavity dimensional variations. The extent of these variations will be investigated.

Because of the results achieved from the aforementioned test, the higher pretune frequency and invar screw are to be specified. Even though the new specifications will result in more uniform drift over the tuning range, it is still desirable to attain greater overall thermal compensation in order to bring more tubes within the desired limits. Recently, it has been found that the cavity header (the washer-like member surrounding the drift tube that forms an internal cavity boundary) impedes the differential expansions between the drift tube and the tube body (longitudinal cavity wall), and thus tends to neutralize the thermal compensation contributed by that portion of the drift tube which is outside the cavity. In order to investigate this proposed effect, some special cavity headers are being made of three different thickness materials. Particular care will be taken to control the amount of brazing fillet between the header and adjacent parts during assembly in order that header flexibility will not be impaired. The effect upon vibration-frequency stability through and beyond the required limits of vibration will be surveyed due to probable changes in mechanical resonance points.

Test data from tubes assembled using the pre-plated, Nicoro-brazed anode plate/drift tube assemblies³ indicates approximately 1 mc less thermal compensation than normal. This is probably due to the increased thickness of high-expansion-rate material (copper plate and copper brazing alloy) between the flared portions of the drift tube and the anode plate. Because of the indicated tendency toward poorer drift characteristic, no further tests are to be run using this technique. However, it has been found that poor plating on the moly drift tube can be detected before assembly by

2 Varian Engineering Report No. 132-20
3 Varian Engineering Report No. 132-22

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putting a "flash" plate of copper on the drift tube, followed by test firing and inspection, without any apparent undesirable results on tube characteristics. This method of handling has been established.

Pursuant to new mechanical requirements, tubes are now being molded with reflector leads at right angles to the tube axis (in the same direction as the cathode leads). As a result of this change, the molding operation will be slowed temporarily until regular production molds are completed. (This effect is noted in Table III under "Number of Tubes Submitted" in First Finishing Work Station.)

Production of external cavities has been halted pending availability of new parts, jigs, and fixtures needed to provide the new tuning screw mechanism reported last month.

Performance data of tubes tested in the month of April and the first two weeks of May are given in Tables I and II, respectively. Production data for tubes in process in May are given in Table III.

TABLE I

AVERAGE PERFORMANCE DATA OF TUBES TESTED

DURING APRIL
(First Test)

Beam Voltage = 300 v

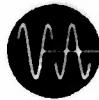
Frequency (mc)	8800	9600
Beam Current (ma)	40.2 (98)	40.00 (98)
Reflector Voltage (v)	63.12 (98)	92.12 (98)
Power Output (mw)	51.91 (98)	66.88 (98)
Bandwidth (mc)	74.10 (98)	51.47 (98)
Mod. Sens. (mc/v)	4.00 (98)	2.58 (98)
Drift, 10 minutes (mc)	-2.61 (58)	-2.69 (93)

Only 15.4 per cent of 26 tubes tested for drift were within the 3-mc drift requirement at both ends of the tuning range.

The number in parenthesis indicates the number of tubes tested.

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TABLE II

AVERAGE PERFORMANCE DATA OF TUBES TESTED IN
THE FIRST TWO WEEKS OF MAY
(First Test)

	<u>Beam Voltage = 300 v</u>	
Frequency (mc)	8800	9600
Beam Current (ma)	40.47 (57)	40.34 (56)
Reflector Voltage (v)	65.42 (57)	93.25 (56)
Power Output (mw)	51.79 (57)	69.23 (56)
Bandwidth (mc)	76.54 (57)	55.93 (56)
Mod. Sens. (mc/v)	3.99 (56)	2.68 (56)
Drift, 10 minutes (mc)	-3.55 (21)	-2.81 (55)

Only 19.1 per cent of 21 tubes tested for drift were within the 3-mc drift requirement at both ends of the tuning range.

The number in parenthesis indicates the number of tubes tested.

TABLE III

PRODUCTION DATA - TUBES IN PROCESS IN MAY

Work Station	Number of Tubes Submitted	Yield
Body Assembly	171	96%
Pretune	165	100%
Seal In	186	97%
Exhaust	151	99%
Aging	153	97%
First Test	130	94%
First Finish	34	71%
Second Test	45	100%
Second Finish	62	100%
Final Test	67	94%
Final Inspection	62	100%

56% Compounded -
All Stations

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In regard to V-52 equipment status, during the month of May previously authorized modifications were made to the wire-plating machine. Trouble had been encountered with the drive mechanism, since the variable speed torque converter originally installed would not pull the wire through the plating bath at a constant rate, and the varying tension on the wire made it very difficult to maintain uniform wire cross-section and plating thickness. The motor drive was therefore replaced by a Graham variable speed transmission, and a constant speed wire drive has now been achieved. All pulleys that are immersed in chemical solutions were changed from Micarta to Nylon, and favorable results have been obtained to date. One difficulty remains that has not been corrected. With the higher wire speeds made possible by the use of DuPont high-speed copper-plating solution, the wire cut-off mechanism does not operate rapidly enough to cut the wire without buckling it slightly. A new cutting mechanism that moves at the same speed as the wire during the cutting operation will be required and is currently being designed.

Quotations have been received from suppliers on a new small atmosphere-type electric furnace to be used to fabricate glass stems. As soon as the optimum specifications for this furnace are determined, an order will be placed.

PROGRAM FOR NEXT INTERVAL

Investigations will be made of the variations in the tuning curve due to external cavity dimensional variations.

Tubes will be built using special thin cavity headers to determine the effect on drift and vibration-frequency stability.

A new cutting mechanism for the wire-plating machine will be designed.

Estimated expenditures during May 1954: \$33,400.00

Estimated man-hours during May 1954: 2800

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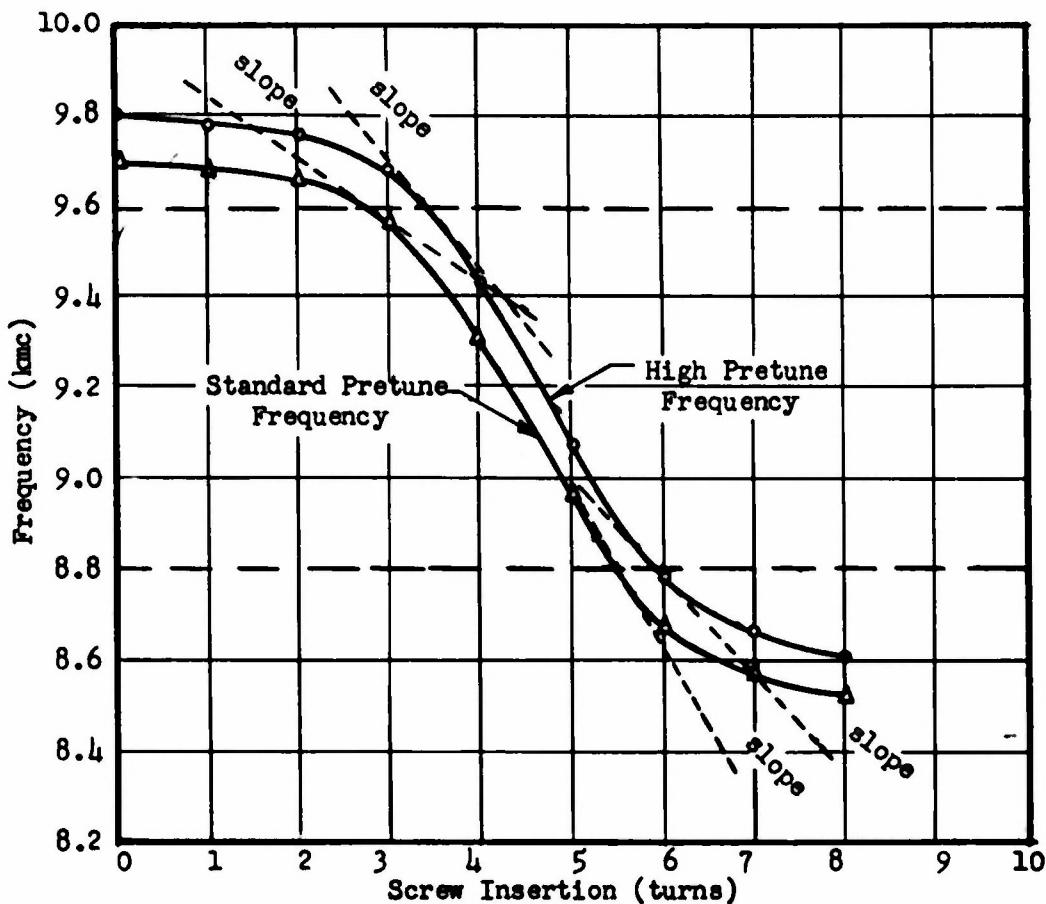


FIGURE 1
FREQUENCY vs TUNING SCREW INSERTION
(TYPICAL TUBES)

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